IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
Smith et al.

Confirmation No.: 7897

Serial No.: 10/656,574

Filed: 5 September 2003

Group Art Unit: 1733

Examiner: Aftergut, Jeff H

For: CONDUIT AND METHOD OF
FORMING

Attorney Docket. No.:
1171/41365/Case 135

STATUTORY DECLARATION OF PETER N PLIMMER
UNDER 37 C. F. R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I, PETER NEVILLE PLIMMER, of Auckland, New Zealand, do solemnly and sincerely hereby declare as follows:

1.   I am a Dr (Ph.D.) of organic chemistry and currently a part time lecturer at The University of Auckland, teaching several courses on polymer technology.

2.   Prior to retiring to New Zealand, I had a 30 year career with the DuPont Company in the United States. At retirement I held the position of Manager of Technology Development.

3   I am a resident of 493 East Coast Road, Browns Bay, North Shore City, New Zealand. A copy of my *Curriculum Vitae* is attached as **Exhibit PNP1.**

4.   I have read US 2,748,830 - Method and apparatus for making spiral wound synthetic piping and tubing (Nash), and US 2,250,430 - Process and apparatus for forming tubing (Wade).

5.   **Processing Modified Cellulose-Based Polymers**

Looking at US Patent 2,250,430 (Wade), it would appear that they seem to recognize that a cellulose-based polymer cannot be heat welded or fused to itself, because:

    (a) They prefer the use of "*pretreated* tube-forming material which makes it more plastic" (page 1, column 1, lines 35-40) and,

    (b) In the section p.2, column 2, line 65 to p.3 column 1, line 7; is the statement:

"…to material which is inherently heat-fusible, i.e. a material such as cellulose acetate, as well as material *rendered heat sealable by reason of being treated with an adhesive solvent and/or softening agent or which has been coated with a heat-fusible composition*".

6.   There is a major error in (b) above. <u>Cellulose acetate is *not* an inherently heat-fusible material,</u> since it decomposes before it actually melts.

7.   However, a heat-fusible version was available commercially (Tennessee Eastman used to offer a Tenite^R product line) as cellulose acetate *modified by the addition of considerable level of a material called a "plasticizer"* (up to 25% by weight, Principles of High Polymer Theory and Practice, Schmidt and Marlies p. 311 & p. 653 attached as **Exhibit PNP2 and PNP3**).

8.   **Solvent Welding**

Plasticizers present in a product such as Tenite^R act like 'internal lubricants', allowing the cellulose acetate polymer chains to slide over themselves when exposed to heat and pressure. Thus a *plasticized cellulose acetate* will appear to 'melt' and 'flow' when processed by conventional thermoplastic moulding techniques.

9.   So, if a plasticizer is present in a material such as cellulose acetate film, it will inevitably be located at the interface between two overlapping plasticized cellulose acetate *films*, and will act as a 'softening agent'. This will provide a site for adhesion (fusing) since the cellulose acetate polymer chains will 'migrate' from one film layer to the other, through the plasticizer, to form a continuous (adhesive) linkage between the overlapping layers.

This technique is called "solvent welding" and is commonly used in the plastics industry (Schmidt and Marlies p. 653 attached as **Exhibit PNP3**). The heat and pressure manufacturing

conditions described in Wade would encourage 'solvent welding' of a *modified* cellulose acetate to occur.

10. However, US 2,748,830 (Nash) at Column 2, line 23 refers to "plain or unlacquered cellophane" and does not suggest a modified cellulose acetate material. Cellulose acetate is not the same material as regenerated cellulose (cellophane).

12. **Heat Welding of Cellulose-Based Polymers**

The answer to the question regarding whether or not "plain or unlacquered cellulose" (as disclosed in Nash) is a heat-weldable material, is an emphatic 'no'. Regenerated Cellulose (cellophane) *does not* melt as it *decomposes* before reaching a temperature at which it's molecular chains become "mobile" enough undergo melt fusion (welding).
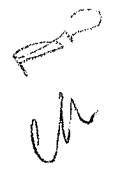
13. **Processing of Cellulose-Based Polymers**

Cellulose, or more specifically regenerated cellulose, is commonly called *viscose rayon* when formed into fibre, and *cellophane* when formed into film. The term 'formed' is used because the process used to make this fibre or film shape does not involve melting the cellulose – these shapes are the result of a spinning or casting process where the starting material is dissolved in a solvent (Fred Billmeyer, Textbook of Polymer Science, pp. 445 to 447 attached as **Exhibit PNP4**).

14. This method of processing is employed because the melting point of cellulose is far above the temperature at which it decomposes. Only a few cellulose derived materials actually melt E.g. Ethyl cellulose, which has a melt point of 240-255°C. There are no values for melting point for other cellulose-based polymers recorded in the Handbook of Chemistry and Physics, 44th Edition, pp 916-919 (attached as **Exhibit PNP5**). There are only a few values for melting point for other cellulose-based polymers recorded in Schmidt and Marlies p. 182 (attached as **Exhibit PNP6**).

15. Since cellophane does not melt, it is impossible for "plain or unlacquered" cellulose film (cellophane) to weld (fuse) to itself.

16. The answer to the question "does the process described in US 2,748,830 (Nash) result in the cellophane layer fusing to itself?" is again 'no'.

17. The process described in 2,748,830 (Nash) would *not* create a permanent weld between overlapping layers of "plain or unlaquered" cellulose (cellophane) film. The temperatures used in the Nash process to 'cure' the polyester resin/fiberglass composite pipe structure would, indeed, cause the cellophane film to shrink, but would have no effect on its ability to bond with itself.

18. Finally, I hereby declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the *United States Code* and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

DECLARED at   )

Auckland, New Zealand)

this ⎽⎽ day of ⎽⎽⎽⎽ 2007)   ⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽⎽

                 PETER N PLIMMER, Ph.D.

BEFORE ME:

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A Solicitor of the High Court of New Zealand/Justice of the Peace

**CHARMIAN S.M. OH
SOLICITOR
AUCKLAND**
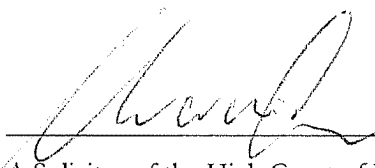
Exhibit PNP1

This is the exhibit marked "PNP1" referred to in the annexed Statutory Declaration of
PETER N PLIMMER Ph.D.

Declared at _Auckland_ this ___23rd___ day of ___March___ 2007

BEFORE ME:

A Solicitor of the High Court of New Zealand

CHARMIAN S.M. OH
SOLICITOR
AUCKLAND

PETER N. PLIMMER Ph.D.

493 East Coast Road, Browns Bay, North Shore City

pplimmer@xtra.co.nz

SUMMARY

Retired after a thirty-year career with the DuPont Company in the United States. This incorporated a broad spectrum of experience involving Research, Market Development, and Manufacturing of high polymers. Held the position of Manager Technology Development at retirement.

RELEVENT EXPERIENCE 1962 - 2005

Independent Consultant, 1992 - present

International

- Developed a novel, oil-resistant thermoplastic elastomer which is currently undergoing market introduction in Europe.
- Developed soft alloys and blends - specifically for use in foamed footwear, wire insulation, and closures.
- Solved critical quality problems in the manufacture of fluoroelastomer seals, and in oil-resistant insulation used in submersible pumps connectors.

Domestic

Part time lecturer at Auckland University, teaching several courses on polymer technology:

- Chemistry 750 (Novel Polymers), at graduate level.
- PAMPITO Levels 4 and 5 - 'Polymer Technology' courses.

- Stages 2 and 3 of the PNZ/Auckland University-promoted 'Diploma in Design and Specification of Plastics' course.

Manager Technology Development, DuPont, 1990 - 1992

- Accelerated the development, aimed at faster penetration of technology into the marketplace, of new "barrier" technology - a recyclable, Freon-resistant, flexible polyamide- replacing non-recyclable thermoset automotive air conditioning hose. Reduced development time and cost by 30%, resulting in $1 million savings.

Senior Research Supervisor, DuPont, 1971 - 1990

Ethylene Copolymers: Worldwide responsibility for both process and product research for polymers designed for packaging, adhesives, sporting goods and industrial end uses. Specific technologies - thermoplastic elastomers, ionomers, chemically functional polymers and reactive compounding.

New Business development: Managed this arm of the Polymers Research and Development Division, test marketing significant new product technology in order to confirm its value-in-use. This included an all-plastic, low attenuation fiber optic cable, corrosion-resistant fluoropolymer/carbon fibre composites for metal replacement, and hydrocarbon-resistant blow moulded HDPE automotive petrol tank.

Fluoropolymers: Directed the process and product research for thermoplastic and thermoset fluoropolymers. This included the development of perfluorovinyl ether monomers as well as fluorinated cure site monomers.

Market Development Representative, DuPont, 1965 - 1971

Fluoropolymers: Part of a 'technical task force' charged with the responsibility of developing new, non-military markets for fluoropolymers (Teflon[R]).

- Worked closely with architectural and engineering design houses in New York City. Developed low friction, load-bearing, sliding ('bearing') pads used in curtain walls, bridges and tunnels.
- Introduced non-burning insulation for signal and power cable for the NYC Transit system.

Research Chemist, DuPont, 1961 - 1965

Fluoropolymers:

- Corrected a 20-year old colour (end group stability) problem peculiar to Teflon[R] TFE.
- Developed the aqueous polymerization process for Teflon[R] PFA.

EDUCATION

Ph.D Organic Chemistry, 1962, "Telomerization and Polymerization of Fluorinated Olefins", University of Durham (England)
B.Sc. (Honours) Chemistry, 1959, University of Durham (England)

PATENTS

US Patent 3,419,512 (1966) 'Non-graying, non-yellowing polytetrafluoroethylene moulding powder'
US Patent 4,503,192 (1985) "Cured elastomers with improved high temperature tear strength"
Pending European patents (1995): 'Compositions of elastomers dispersed in thermoplastic matrices', and 'Process for increasing the crosslinking density of TPE's made by solid state grafting of thermoplastics'
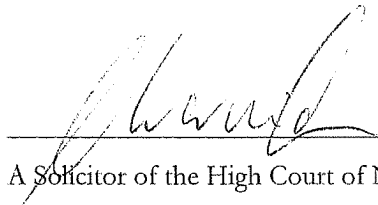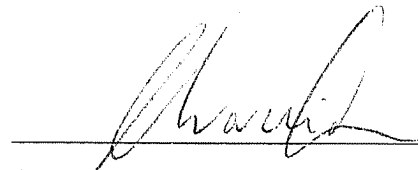
Exhibit PNP2
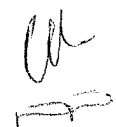
This is the exhibit marked "PNP2" referred to in the annexed Statutory Declaration of PETER N PLIMMER Ph.D.

Declared at _Auckland_ this _23rd_ day of _March_ 2007

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A Solicitor of the High Court of New Zealand

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AUCKLAND

high-polymer industry.   Appropriate references will be found in Appendix A and at the ends of chapters of this text.

801. Binders.   The binder, or binding polymer, is the material that acts as the matrix which ultimately cements the ingredients of the mix

TABLE 8-1.   EXAMPLES OF HIGH-POLYMER MIXES
Automobile Tire-tread Mix (Ready for Vulcanization)

Ingredient	Type	Parts by wt
Rubber	Binder	100
Carbon black	Reinforcing filler	50
Sulfur	Vulcanizing agent	0.5–3.5
Accelerator	Catalyst	0.5–1.5
Zinc oxide	Activator	1–10
Stearic acid	Activator	0.5–2.0
Pine tar	External plasticizer	3
Antioxidant	Aging inhibitor	0.25–1.5

Thermosetting Molding Compound (Ready for Compression Molding)

Ingredient	Type	Wt %
Phenol-aldehyde resin	Binder	43.0
Wood flour	Filler	51.0
Hexamethylenetetramine	Catalyst; hardener	3.7
Black dyes and pigments	Coloring materials	1.5
Metallic soap	Lubricant	0.8

Thermoplastic Molding Compound (Ready for Injection Molding)

Ingredient	Type	Wt %
Cellulose acetate	Binder	74.6
Diethyl phthalate	External plasticizer	24.8
Carmine red	Coloring material	0.4
Montan wax	Lubricant	0.2

Dope for Making Transparent Film (Ready for Casting)

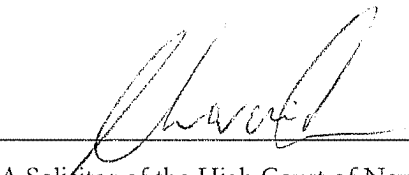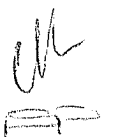| Ingredient	Type	Wt %
Cellulose acetate, medium viscosity	Binder	15
Triphenyl phosphate Dimethyl phthalate	Permanent external plasticizers	{ 2 { 3
Acetone Alcohol Methyl Cellosolve	Solvents, thinners, temporary plasticizers	{ 60 { 10 { 10

Exhibit PNP3

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one another, the situation changes radically. Obviously one has but to liquefy the two adherend surfaces to make bonding possible. This may be achieved by heat or solvent. No adhesive as such need be introduced. Such are the vagaries of language that the bonding of all plastics to one another, whether adhesive as such is required or not, is called *cementing*. Cementing in this sense is characterized by low pressures ranging from contact up to a maximum of perhaps 30 psi. Room temperature is very common although elevated temperatures are sometimes needed.

The cementing of two layers of identical thermoplast to one another is relatively simple and is conducted by any of three general methods.

1. The surfaces are plasticized with volatile solvent and clamped until bonding has resulted.

2. A solution of the thermoplast is made in an appropriate solvent, which is spread on the surfaces before closure. In both (1) and (2) very careful control of solvent release is usually essential to prevent warping, fogging, or undue disturbance of plasticizer concentration, if plasticizer is present.

3. The surfaces are plasticized by heat alone to a point where they will fuse under light pressure. This is sometimes called *welding*, sometimes *heat sealing*. Decomposition and serious loss of plasticizer must be avoided.

Heat for these operations may be applied by hot air, contact with hot metals, or dielectric devices. Seams can be joined between thin sheets of plastic or plastic-impregnated textile fabrics by passing them through a dielectric heater that looks somewhat like a sewing machine. This "sewing without thread" has initiated important technological advances.

The cementing of dissimilar thermoplasts is often more difficult since it may involve the solubility or thermal behavior of two binders and two or more plasticizers. In a few instances, cementing may be effected by solvent alone, but more usually an adhesive as such is required. An instance of the problems to be met is afforded by cellulose acetate and methyl methacrylate. The former contains considerable plasticizer, the latter none; and if migration of this plasticizer into the methacrylate takes place, crazing results. In this and similar cases the adhesive must not only be without plasticizer but must also "seal in" migratory plasticizers.

The cementing of a thermoset to a second plastic requires adhesive as such, in accordance with the discussion at the beginning of this section.

REFERENCES

GENERAL

AMERICAN SOCIETY FOR TESTING MATERIALS, "Symposium on Adhesives," Philadelphia, 1945.

Exhibit PNP4

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available at prices competitive to cotton with advantages of luster, drape, wrinkle and soil resistance, low shrinkage, rapid drying, and good weathering resistance.

Mercerization The chemical treatment of cotton known as *mercerization* to improve its luster has been practiced for many years. The treatment consists in swelling the cotton by concentrated alkali solution and then washing out the alkali. The chemical changes during the process are similar to those in the formation of alkali cellulose. At the end of the treatment there is no molecular difference in the product, but it is somewhat more amorphous than native cotton and, unless the fibers were held under tension during the process, somewhat less oriented.

As a result of these changes, mercerized cotton is slightly lower in density than the untreated material and has increased water absorption, better dye-ability, lower tensile strength, and higher extensibility.

Regenerated cellulose

The term *regenerated cellulose* describes cellulose which has been dissolved by virtue of the production of a soluble chemical derivative, cellulose xanthate, and subsequently reprecipitated. When prepared as a fiber, regenerated cellulose is known as *viscose* or (viscose) *rayon*. Traditionally both viscose and cellulose acetate have been known as rayons, but the term is now restricted to viscose in order to avoid confusion. As a film, regenerated cellulose is known by the generic term *cellophane*.

Manufacture The first step in the production of regenerated cellulose, starting with purified cellulose usually obtained from wood pulp, is the formation of *alkali* or *soda cellulose*. This is produced by the reaction of cellulose with strong alkalis at low temperatures, and is a further step in the reaction of mercerization.

The exact structure of alkali cellulose is not completely understood. It is certain that some of the alkali (say NaOH) is held in the swollen amorphous regions of the cellulose by hydrogen bonding of the hydroxyl radicals to the cellulose molecules. It is also possible that some alcoholates of the type R—ONa are formed, where R is the cellulose residue exclusive of one hydroxyl group.

Alkali cellulose is formed by reacting the cellulose pulp with about 18% aqueous NaOH at room temperature for 15 min to 2 hr. The excess alkali is then pressed out and the mass is shredded into "crumbs" and aged for several days at 25–30°C to promote oxidative degradation of the chains to the desired degree of polymerization.

The alkali cellulose is then converted to cellulose xanthate by the addition of carbon disulfide:

$$R\text{—}OH + CS_2 + NaOH \longrightarrow R\text{—}O\text{—}\overset{\overset{\textstyle S}{\|}}{C}\text{—}S\text{—}Na + H_2O$$
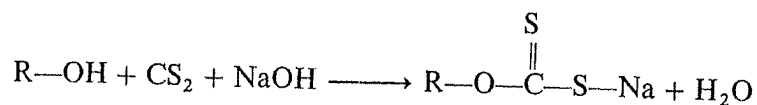
where R is a cellulose residue. The average degree of xanthation is about one CS_2 for every two cellulose residues. Since the reaction takes place heterogeneously by the addition of liquid or gaseous CS_2 to the alkali cellulose crumbs, the xanthation in some regions may correspond to the dixanthate or higher.

The mass retains most of its physical form but becomes more sticky or gelatinous and takes on a deep orange color and a characteristic and highly unpleasant odor. It is held at 25–30°C for 1–3 hr with about 10% CS_2 by weight and then evacuated to remove excess CS_2. It is now dissolved in dilute NaOH, becoming completely soluble in this reagent for the first time. The solution is known as viscose. Its color and odor are due to products of side reactions such as Na_2CS_3, NaSH, H_2S, sulfides, and polysulfides.

A fresh viscose solution cannot easily be coagulated and must be allowed to "ripen" for a few days. The changes taking place during ripening are complex, and the reaction must be carefully controlled by time and temperature to avoid premature coagulation.

Cellulose xanthate is essentially unstable and decomposes gradually during the ripening process by hydrolysis and saponification. At the end of the ripening period, enough cellulose residues have been regenerated so that coagulation is imminent. The viscose is then spun into a bath containing sulfuric acid to effect the regeneration of the remaining cellulose residues and coagulate the polymer:

$$R\text{—}O\text{—}\overset{\overset{\textstyle S}{\|}}{C}\text{—}S\text{—}Na + H^+ \longrightarrow R\text{—}OH + CS_2 + Na^+$$
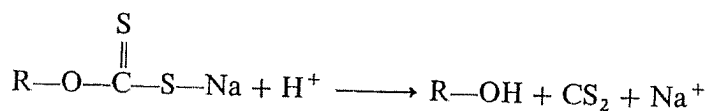
If the spinning process places no mechanical stress on the polymer, it can be obtained in a completely amorphous form. This form is unstable, however, and the application of rather small stresses by such processes as stretching, working, spinning, and extruding causes the cellulose to crystallize (usually to a different structure from that of the native material). In this case, the ordering of the chains is not as great as in the native material, and the density and stiffness of the regenerated product are lower. These differences in density, stiffness, strength, and other properties between native and regenerated cellulose can be accounted for by differences in chain length, chain length distribution, crystal structure, degree of crystallinity, orientation, crystallite size, nature and amount of impurities and other flaws, degree of

swelling, and chemical reactivity. All these changes on regeneration are in line with the structural differences outlined above.

Normal tenacity Viscose rayon normally has a tenacity of 2–2.5 g/denier, somewhat lower than that of cotton (3–5 g/denier). Its wet tenacity is only about half the dry value but is still adequate for laundering. The moisture absorption of viscose is about twice that of cotton. The elasticity is not high (typically 15% elongation at break), and the fiber shows considerable visco-elastic character.

Viscose of normal tenacity is primarily an apparel fiber, but its popularity is declining. Several one-time major manufacturers have ceased producing the material, and the others are operating well below capacity.

High tenacity In contrast to apparel rayon, a high-tenacity product (3–6 g/denier) is produced by stretching the fibers just short of their breaking point in the spinning bath. Considerable orientation (and crystallinity) is so introduced. High-tenacity rayon has lower elongation and moisture absorption than the apparel material and is used almost exclusively for tire cord. This market (120 million lb in 1969) is, however, dwindling rapidly with the increasing use of polyester and glass fibers in tires.

Cellophane

In the manufacture of cellophane the viscose solution is extruded as film and then immersed in a bath of ammonium and sodium sulfate and dilute sulfuric acid, which removes the xanthate groups and precipitates the cellulose. The film is passed through various washing, bleaching, and desulfurizing baths, and finally through a bath of glycerol, glucose, or a polyhydric alcohol, which is imbibed and acts as a plasticizer. The film is then dried. For applications in which low moisture permeability is desired, it is coated with a mixture of nitrocellulose and various plasticizers and waxes.

Cellophane is a thin (0.001–0.002 in.) film of fair physical properties. Its tensile strength is good, but its tear strength, impact strength, and resistance to flexing are poor compared to those of newer film materials. The permeability of the uncoated film to water vapor and to water-soluble gases is extremely high. The coated material passes about 0.3 gram of water vapor/sq in./hr at 40°C. Cellophane is widely used as a wrapping and packaging material.

Cellulose sponges are made by stirring lumps of a salt such as sodium sulfate into viscose, coagulating, and washing out the salt to leave a porous

Exhibit PNP5

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_____

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CHARMIAN S.M. OH
SOLICITOR
AUCKLAND

No.	Name	Synonyms	Formula	Mol. Wt.
2605	Carvacrol......	2-p-cymenol; cymophenol.	$CH_3(C_3H_7)C_6H_3$-OH	150.21
2606 2607	——, hexahydro-. Carvacrylamine.	See Carvomenthol. 2-p-cymylamine; 2-amino-p-cymene; 5-isopropyl-2-methylaniline; cymidine	$(CH_3)_2CH(CH_3)$-$C_6H_3.NH_2$	149.23
2608 2609	Carvene. Carvenone.	See d-Limonene. 3-p-menthen-2-one.	$C_{10}H_{16}O$.	152.23
2610 2611 2612 2613	Carveol, dihydro-. Carvol. Carvomenthene. Carvomenthol.	p-menth-8(9)-en-2-ol. See d-Carvone. 1-p-menthene. 2-p-menthanol; hexahydro-carvacrol	$C_{10}H_{17}OH$. $C_{10}H_{18}$ $C_{10}H_{19}.OH$	154.25 138.25 156.26
2614	Carvone, dihydro-.	p-menth-8(9)-en-2-one	$C_{10}H_{16}O$.	152.23
2615	dl-Carvone, oxime.	dl-carvoxime.	$C_{10}H_{14}.NOH$.	165.23
2616	d-Carvone......	d-6,8(9)-p-menthadien-2-one; carvol	$C_{10}H_{14}O$.	150.21
2617 2618	dl-Carvoxime. Caryophyllin.	See dl-Carvone, oxime.	$(C_{10}H_{16}O)_3$.	456.80
2619 2620 2621	d-Catechin. Catechol. d-Catechol.	See d-Catechol. d-catechin; 3,5,7,3',4'-flavan-pentol (one form); 2,3,4-dihydroxyphenyl)-3,5,7,-chromantriol (one form). See also Pyrocatechol.	$C_{15}H_{14}O_6$.	290.26
2622 2623	Cedrarine. Cedrene (artificial)	See Quinazoline, 3,4-dihydro-3-phenyl-.	$C_{15}H_{24}$.	204.34
2624 2625	Cedriret. Cellobiose.	See Cerulignone. cellose; glucose β-glucoside.	$C_{12}H_{22}O_{11}$.	342.30
2627	——, octaacetate (α).....	octaacetylcellobiose.....	$C_{12}H_{14}O_3$-$(OOCCH_3)_8$	678.59
2628 2629 2630 2631 2632 2633	Cellose. "Cellosolve" ——, benzyl. ——, butyl. ——, methyl. Cellulose.	See Cellobiose. See Ethanol, 2-ethoxy-. See Ethanol, 2-benzyloxy-. See Ethanol, 2-butoxy-. See Ethanol, 2-methoxy-.	$(C_6H_{10}O_5)_x$.	(162-14)$_x$

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Water	Alcohol	Ether, etc.
2605	col. oily liq., 1.52295	0.976	0.5 (1-2)	237.9	v. sl. s.	s.	s. eth., alk.
2606 2607	oil, 1.5431°.	0.9942²⁰/4	-16	241; 118¹²	v. sl. s.	s.	s. eth.
2608 2609	liq., 1.4632?¹⁹	0.9283²⁰/4		233	i.		
2610 2611 2612 2613	liq., 1.48168. col. oily liq. oil, 1.45296.	0.927 0.820⁹ 0.904¹⁴		225 175 222 (220)	s. s.		s. chl.
2614	oily liq., 1.47147¹⁹, [α]-19°, [α]-16°D.	0.9253²⁰/4		220-1			s. chl.
2615	monocl. cr.		93-4 (70-71)		s.		
2616	col. liq., 1.499948₁₃, [α]+62.07D, (l/c) -39-34°¹⁸ D	0.9608²⁰/4		230 (227-8; 225)	v. sl. s.	s.	∞ eth.; s. chl.
2617 2618	silky need. [α]+54.5°D in al.			subl. 285	sl. s.	sl. s.	v. s. eth.; i. alk.
2619 2620 2621	wh. cr. powd. or need. f. w.	1.344⁴/4	175 (217)	240-5 d.	s.		0.59 eth.; s. et., ac., alk.
2622 2623	col. liq., 1.5001¹⁹, [α]-52.6°₀.	0.929		262-3			
2624 2625	col. need., [α]+24.4°D, in w.		225		g.		v. v. sl.; i. acet.
2627	col. silky need., [α]+41.5°₀ in chl.		229-9		i.		i. eth.
2628 2629 2630 2631 2632 2633	wh. amorph.	1.27-1.61			i.		i. eth., all ord. org. solv.; s. $Cu(NH_3)_4(OH)_2$.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.	No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
										Water	Alcohol	Ether, etc.
2636	Cellulose, acetate, tri-	....	$C_6H_7O_2(OOCCH_3)_3$	288.25	2636	ylsh. amor.....	.....	.....	.....	i.	i.	i. eth., acet.; s. chl., glac. ac. a.; nitro-bz.
2636M	—, ethyl ether......	ethylcellulose; triethyl-cellulose	2,3, and 6 "OH" groups ethylated	in-definite	2636M	fine wh. need. f. 0.2% soln. in bz.	....	240-255	......	i.	s.	s. warm eth.
2637	—, hexanitrate......	chief constituent of guncotton	$C_{12}H_{14}(ONO_2)_6O_4$	594.28	2637	wh. amor......	1.66	ign. 160-70	......	i.	sl. s.-d.	i. eth., bz.; v. sl. s. eth. bz.; a. nitro-bz. ‡
2638	—, pentanitrate......		$C_{12}H_{15}(ONO_2)_5O_5$	549.28	2638	wh. amor......	ca. 1.66			i.	i.	i. eth., bz.; s. eth.+al.
2639	—, tetranitrate......	consituent of collodion	$C_{12}H_{16}(ONO_2)_4O_6$	504.28	2639	wh. amor......	1.66			i.	i.	i. eth., bz.; s. eth.+al., me. al.
2640	—, trinitrate........	consituent of collodion	$C_{12}H_{17}(ONO_2)_3O_7$	459.28	2640	wh. amor.....	1.66			i.	s.	s. me. al., b. glac. ac. s.; i. bz.
2640M 2641 2642	—, ethyl-. Cerane. Cerotic acid.......	See Cellulose, ethyl ether. isotricosane? hexacosanoic acid*.......	$C_{23}H_{48}$ $CH_3(CH_2)_{24}COOH$	368.79 396.68	2640M 2641 2642	cr. f. eth.; col. need. f. al.	0.8396¹⁰	61 87.7 (80-2) d.	207.⁷ d.	i.	s. v. sl. s.	s. eth. 20⁴ eth.; s. acet., bz.
2643 2644	Cerotin. Ceruligninone......	See Ceryl alcohol. 3,3',5,5'-tetramethoxydiphenoquinone; coeruligninone; cedriret	$C_{20}H_{24}O_6$	304.29	2643 2644	bluish gr. need.	d.			i.	i.	i. H_2SO_4, phenol; i. ord. org. solv.
2645	Ceryl alcohol.......	1-hexacosanol*; cerotin; n-hexacosyl alcohol	$C_{26}H_{54}O$	382.70	2645	col. rhomb. pl.		79.6-79.8	305*d.	i.	s.	s. eth.
2646 2647	Cetene. Cetyl alcohol.......	See Hexadecene*. 1-hexadecanol*; n-hexadecyl alcohol; ethal	$CH_3(CH_2)_{15}OH$	242.44	2646 2647	leaf f. al., 1.4283²⁸·⁵	0.8176⁵⁰/₄	49.3	190¹⁵; 344	i.	102	s. eth.; 97⁷⁴ me-al.; s. bz.
2648 2648M	Cetane. Cetylamine (n);	See Hexadecane. 1-aminohexadecane; hexadecylamine*	$CH_3(CH_2)_{15}NH_2$	241.45	2648 2648M	col. cr.....			322.5; 143.9³	i.	s.	s. eth.
2649 2650 2651	Ceryl cyanide. Cetylene. Cetyl ether.	See Margaronitrile. See 2.Hexadecyne*. 1-hexadecyloxyhexadecane*; hexadecyl ether; diethyl ether	$(C_{16}H_{33})_2O$	466.85	2649 2650 2651	leaf. --- ...		55	270 d.	sl. s.	s.	s. eth.
2652	Cetyl iodide.......	1-iodohexadecane*; n-hexadecyl iodide	$CH_3(CH_2)_{15}I$	352.35	2652	leaf f. al., 1.4806	1.123	22	211¹⁵	i.	s.	s. eth.
2653	Cetyl sulfate......	hexadecyl sulfate; di-n-hexadecyl sulfate	$[CH_3(CH_2)_{15}O]_2SO_4$	546.91	2653	pa. yel. rhomb. pl.		66.2-6.3		i.	....	....
2654 2654M 2655	Cevadine. Cevitramic acid. Chalcone...........	See Veratrine (crystalline). See l-Ascorbic acid. benzalacetophenone; benzyl-idenacetophenone; phenyl styryl ketone; 1,3-diphenyl-2-propen-1-one	$C_6H_5CH{:}CH{\cdot}CO{\cdot}C_6H_5$	208.25	2654 2654M 2655	col. leaf. f. bz.	1.071⁶¹/₄	62 (55-7)	348	i.	sl. s.	s. eth., chl., bz., CS₂, conc. H₂SO₄; v. sl. s. lgr.
2656	d-Chaulmoogric acid	13-(2-cyclopentenyl)tri-decanoic acid	$CH_2{=}CH{\cdot}CH_2{\cdot}C_6H_7{-}H(CH_2)_{11}COOH$	280.44	2656	col. leaf. f. al. $[\alpha]+62°$ in chl	....	68.5	247-8³	i.	v. sl. s.	s. eth., chl.
2557	Chavibetol...........	5-allylguaiacol; betel phenol; d-13-(2-cyclopentenyl) tri-decanoic acid	$CH_3{\cdot}CH{:}CH{\cdot}C_6H_2{-}(OH)(OCH_3)$	164.20	2557	liq. 1.5413²³	1.0680¹⁵/₁₅	8.5	254-5	i.	s.	s. eth.

*Name approved by the International Union of Chemistry.

†For explanations and abbreviations see beginning of table.
‡All nitro celluloses are soluble in acet., et. ac., amyl acetate.
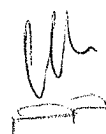
Exhibit PNP6

This is the exhibit marked "PNP6" referred to in the annexed Statutory Declaration of PETER N PLIMMER Ph.D.

Declared at _Auckland_ this _23rd_ day of _March_ 2007

BEFORE ME:

_____
A Solicitor of the High Court of New Zealand

CHARMIAN S.M. OH
SOLICITOR
AUCKLAND

of an amorphous material. If it is held at room temperature without further treatment, it gradually hardens while crystallizing with a random crystal arrangement, as shown by a pronounced powder diagram (Fig. 5-7a). Not only are the crystallization phenomena every bit as definite as with a low-molecular-weight compound, but the rate of crystallization at room temperature is considerably greater than that of amorphous sulfur, a significant comparison because the melting points of polyvinylidene chloride and sulfur are similar. In a few cases, high polymers melt sharply. For example, in polyhexamethylene sebacamide (polyamide 6-10), the solid-liquid transition occurs over a 2° interval under equilibrium conditions with little hysteresis. In most cases however, there is considerable hysteresis, which is not surprising in view of the lengths of the molecules and their consequent low mobility and hampered motions.

TABLE 5-8. FIRST-ORDER TRANSITION (TRUE MELTING POINTS) OF HIGH POLYMERS
(Melting points of some polyesters given in Table 1-2)

Polymer	Highest First-order Transition Temperature of Unstressed Substance, Deg C
Hevea rubber	About 25
Chloroprene	About 30
β-Gutta-percha	56
α-Gutta-percha	65
Thiokol A	About 70
Polyethylene	115
Polyvinylidene chloride	185
Cellulose tributyrate	185
Polyamide 10-10	194
Polyamide 6-10	209
Cellulose tripropionate	225
Polyamide 10-6	230
Polyamide 6-6	250
Polyamide 4-6	278
Cellulose triacetate	302
Polytetrafluoroethylene	327

Data from several sources, notably
COFFMAN, D. D., *et al.*, *J. Polymer Sci.*, **2**, 306 (1947).
MALM, C. J., C. R. FORDYCE, and H. A. TANNER, *Ind. Eng. Chem.*, **34**, 430 (1942).
WOOD, L. A., in "Advances in Colloid Science," Vol. 2, MARK and WHITBY, editors, Interscience Publishers, Inc., New York, 1946.

Polyvinylidene chloride and all other high polymers exhibiting such first-order transitions differ in one significant respect from low-molecular-weight substances, *viz.*, during the first-order transition the material may become transparent and softer, but it by no means turns into a mobile liquid. In some cases the substance becomes a very viscous liquid, and in other cases it becomes a rubber. That high polymers do not melt to mobile liquids may be explained as follows (see also Sec. 321).